

WHAT IS CLAIMED IS:

1. An exhaust emission control apparatus for an internal combustion engine, comprising:

5           an exhaust passage;

          a NOx retainer agent that is provided in the exhaust passage, and that takes up and retains NOx from an incoming exhaust gas if an air-fuel ratio of the incoming exhaust gas is lean of stoichiometry, and that releases NOx retained by the NOx retainer agent if the air-fuel ratio of the incoming exhaust gas is substantially stoichiometric or rich of stoichiometry;

10           a sulfur component retainer agent that is provided in the exhaust passage upstream of the NOx retainer agent, and that takes up and retains a sulfur component contained in the incoming exhaust gas; and

          a controller that performs a NOx releasing process of adjusting the air-fuel ratio of an exhaust gas flowing into the sulfur component retainer agent so that the air-fuel ratio of an exhaust gas flowing into the NOx retainer agent becomes substantially stoichiometric or rich of stoichiometry if NOx retained by the NOx retainer agent is to be released, and that prohibits the air-fuel ratio of the exhaust gas flowing into the sulfur component retainer agent from becoming substantially stoichiometric or rich of stoichiometry if an amount of the sulfur component retained by the sulfur component retainer agent is at least a first predetermined amount.

2. The exhaust emission control apparatus according to claim 1, wherein the exhaust passage is provided with a bypass passage that causes an exhaust gas to bypass the NOx retainer agent, and a flow regulator valve that controls an amount of flow of the exhaust gas flowing into the bypass passage, and

          wherein if the amount of the sulfur component retained by the sulfur component retainer agent is at least a second predetermined amount and it is possible to release the sulfur component from the sulfur component retainer agent, the controller causes a predetermined condition for releasing the sulfur component to be fulfilled so as to release the sulfur component from the sulfur component retainer agent, and causes at least a most portion of the exhaust gas to flow into the bypass passage by controlling the flow regulator valve.

3. The exhaust emission control apparatus according to claim 2, wherein the predetermined condition for releasing the sulfur component is a condition that the air-fuel ratio of the exhaust gas be substantially stoichiometric or rich of stoichiometry and a temperature of the sulfur component retainer agent be at least a sulfur component release temperature.
4. The exhaust emission control apparatus according to claim 2, wherein when it is possible to release the sulfur component from the sulfur component retainer agent means when it is possible to easily fulfill the condition for releasing the sulfur component.
5. The exhaust emission control apparatus according to claim 2, wherein the first predetermined amount and the second predetermined amount are equal.
6. The exhaust emission control apparatus according to claim 1, wherein the exhaust passage is provided with an annular passage that branches from a branching portion of the exhaust passage and returns to the branching portion and that has the NO<sub>x</sub> retainer agent in an intermediate portion of the annular passage, and a flow regulator valve that controls an amount of flow of an exhaust gas into the annular passage and a direction of flow of the exhaust gas into the annular passage, and wherein if the amount of the sulfur component retained by the sulfur component retainer agent is at least a second predetermined amount and it is possible to release the sulfur component from the sulfur component retainer agent, the controller causes a predetermined condition for releasing the sulfur component to be fulfilled so as to release the sulfur component from the sulfur component retainer agent, and causes at least a most portion of the exhaust gas to flow downstream of the branching portion without flowing into the annular passage by controlling the flow regulator valve.
7. The exhaust emission control apparatus according to claim 6, wherein the predetermined condition for releasing the sulfur component is a condition that the air-fuel ratio of the exhaust gas be substantially stoichiometric or rich of stoichiometry

and a temperature of the sulfur component retainer agent be at least a sulfur component release temperature.

5 8. The exhaust emission control apparatus according to claim 6, wherein when it is possible to release the sulfur component from the sulfur component retainer agent means when it is possible to easily fulfill the condition for releasing the sulfur component.

10 9. The exhaust emission control apparatus according to claim 6, wherein the first predetermined amount and the second predetermined amount are equal.

15 10. The exhaust emission control apparatus according to claim 1, wherein the first predetermined amount and the second predetermined amount are calculated from a temperature of the sulfur component retainer agent.

20 11. The exhaust emission control apparatus according to claim 1, wherein the first predetermined amount and the second predetermined amount are calculated from a temperature of the sulfur component retainer agent and the air-fuel ratio of the exhaust gas flowing into the sulfur component retainer agent.

25 12. The exhaust emission control apparatus according to claim 1, further comprising a fuel supply device that is disposed in the exhaust passage upstream of the sulfur component retainer agent and that supplies a fuel into the exhaust gas flowing into the sulfur component retainer agent if the NO<sub>x</sub> releasing process is to be performed.

30 13. The exhaust emission control apparatus according to claim 1, wherein the NO<sub>x</sub> retainer agent is supported on a particulate filter that traps a particulate substance contained in the incoming exhaust gas.

14. An exhaust emission control apparatus for an internal combustion engine, comprising:  
an exhaust passage;  
a NO<sub>x</sub> retainer agent that is provided in the exhaust passage, and that takes up and retains NO<sub>x</sub> from an incoming exhaust gas if an air-fuel ratio of the incoming

exhaust gas is lean of stoichiometry, and that releases NO<sub>x</sub> retained by the NO<sub>x</sub> retainer agent if the air-fuel ratio of the incoming exhaust gas is substantially stoichiometric or rich of stoichiometry;

5 a sulfur component retainer agent which is provided in the exhaust passage upstream of the NO<sub>x</sub> retainer agent for taking up and retaining a sulfur component contained in the incoming exhaust gas, and an outflow of the sulfur component from which increases with an increase in an amount of the sulfur component retained by the sulfur component retainer agent if the air-fuel ratio of the incoming exhaust gas is substantially stoichiometric or rich of stoichiometry; and

10 a controller that prohibits the air-fuel ratio of the exhaust gas flowing into the sulfur component retainer agent from becoming substantially stoichiometric or rich of stoichiometry if the outflow of the sulfur component from the sulfur component retainer agent is to be kept less than a predetermined amount.

15 15. An exhaust emission control method for an internal combustion engine, comprising the step of:

causing an exhaust gas to flow into an exhaust passage;

causing a sulfur component retainer agent provided in the exhaust passage to capture and retain a sulfur component contained in an incoming exhaust gas;

20 causing a NO<sub>x</sub> retainer agent provided in the exhaust passage downstream of the sulfur component retainer agent to capture and retain NO<sub>x</sub> from the incoming exhaust gas if an air-fuel ratio of the incoming exhaust gas is lean of stoichiometry, and causing the NO<sub>x</sub> retainer agent to release NO<sub>x</sub> retained by the NO<sub>x</sub> retainer agent if the air-fuel ratio of the incoming exhaust gas is substantially stoichiometric or rich of stoichiometry;

25 performing a NO<sub>x</sub> releasing process of adjusting the air-fuel ratio of an exhaust gas flowing into the NO<sub>x</sub> retainer agent so that the air-fuel ratio of the exhaust gas becomes substantially stoichiometric or rich of stoichiometry if NO<sub>x</sub> retained by the NO<sub>x</sub> retainer agent is to be released; and

30 prohibiting the air-fuel ratio of an exhaust gas flowing into the sulfur component retainer agent from becoming substantially stoichiometric or rich of stoichiometry if an amount of the sulfur component retained by the sulfur component retainer agent is at least a first predetermined amount.

16. The exhaust emission control method according to claim 15, wherein if the amount of the sulfur component retained by the sulfur component retainer agent is at least a second predetermined amount and it is possible to release the sulfur component from the sulfur component retainer agent, a predetermined condition for releasing the sulfur component is caused to be fulfilled, and at least a most portion of the exhaust gas is caused to flow into a bypass passage provided for avoiding inflow of the exhaust gas into the NO<sub>x</sub> retainer agent.
17. The exhaust emission control method according to claim 16, wherein the predetermined condition for releasing the sulfur component is a condition that the air-fuel ratio of the exhaust gas be substantially stoichiometric or rich of stoichiometry and a temperature of the sulfur component retainer agent be at least a sulfur component release temperature.
18. The exhaust emission control method according to claim 16, wherein when it is possible to release the sulfur component from the sulfur component retainer agent means when it is possible to easily fulfill the condition for releasing the sulfur component.
19. The exhaust emission control method according to claim 16, wherein the first predetermined amount and the second predetermined amount are equal.
20. The exhaust emission control method according to claim 15, wherein if the amount of the sulfur component retained by the sulfur component retainer agent is at least a second predetermined amount and it is possible to release the sulfur component from the sulfur component retainer agent, a predetermined condition for releasing the sulfur component is caused to be fulfilled, and at least a most portion of the exhaust gas is caused to flow downstream of a branching portion of the exhaust passage without flowing into an annular passage that branches from the branching portion of the exhaust passage and returns to the branching portion and that has the NO<sub>x</sub> retainer agent in an intermediate portion of the annular passage.
21. The exhaust emission control method according to claim 20, wherein the predetermined condition for releasing the sulfur component is a condition that the air-

fuel ratio of the exhaust gas be substantially stoichiometric or rich of stoichiometry and a temperature of the sulfur component retainer agent be at least a sulfur component release temperature.

5        22. The exhaust emission control method according to claim 20, wherein when it is possible to release the sulfur component from the sulfur component retainer agent means when it is possible to easily fulfill the condition for releasing the sulfur component.

10       23. The exhaust emission control method according to claim 20, wherein the first predetermined amount and the second predetermined amount are equal.

24. The exhaust emission control method according to claim 15, wherein the first predetermined amount and the second predetermined amount are calculated from a  
15       temperature of the sulfur component retainer agent.

25. The exhaust emission control method according to claim 15, wherein the first predetermined amount and the second predetermined amount are calculated from a temperature of the sulfur component retainer agent and the air-fuel ratio of the  
20       exhaust gas flowing into the sulfur component retainer agent.

26. The exhaust emission control method according to claim 15, wherein a fuel is supplied into the exhaust gas flowing into the exhaust passage upstream of the sulfur component retainer agent if the NO<sub>x</sub> releasing process is to be performed.

25       27. An exhaust emission control method for an internal combustion engine, comprising:

causing an exhaust gas to flow into an exhaust passage;

causing a sulfur component retainer agent provided in the exhaust passage to

30       capture and retain a sulfur component contained in an incoming exhaust gas;

causing a NO<sub>x</sub> retainer agent provided in the exhaust passage downstream of the sulfur component retainer agent to capture and retain NO<sub>x</sub> from the incoming exhaust gas if an air-fuel ratio of the incoming exhaust gas is lean of stoichiometry, and causing the NO<sub>x</sub> retainer agent to release NO<sub>x</sub> retained by the NO<sub>x</sub> retainer agent

if the air-fuel ratio of the incoming exhaust gas is substantially stoichiometric or rich of stoichiometry;

performing a NO<sub>x</sub> releasing process of adjusting the air-fuel ratio of an exhaust gas flowing into the NO<sub>x</sub> retainer agent so that the air-fuel ratio of the exhaust gas becomes substantially stoichiometric or rich of stoichiometry if NO<sub>x</sub> retained by the NO<sub>x</sub> retainer agent is to be released; and

prohibiting the air-fuel ratio of the exhaust gas flowing into the sulfur component retainer agent from becoming substantially stoichiometric or rich of stoichiometry if an amount of the sulfur component retained by the sulfur component retainer agent is to be kept less than a predetermined amount.